Observations of the Variable Stars W, X, and Y Sagittarii.

By Lieut.-Colonel E. E. Markwick.

The following observations were made at Gibraltar with a binocular field-glass magnifying about five times, and are in continuation of those appearing at p. 338 vol. lv. of the *Monthly Notices.*

W Sagittarii. Thirty-five observations, the star being compared with 14 (U.A.) *Sagittarii*, 5·4 mag. In the table, the first column gives the date of observation for identification. The second is the day and hour of observation reduced to G.M.T., and converted into Julian days and fraction. The next column is the observed magnitude. Maxima were calculated from Dr. Chandler's formula—viz.

1866 Sept. 4 = 240 2849·45 + 7·59460 E.

With the other data in Chandler's second catalogue—viz. variation 4·8 to 5·8 and $M-m=3{\cdot}00\ d$—a typical curve was drawn (see *Monthly Notices*, vol. liv. p. 138), and the observations plotted on the same scale. The distance of each observation from the curve horizontally was then measured off in fractions of a day, those to the left of the curve being negative, and *vice versa.*

The fourth column gives the interval in days elapsed between date of observation and next preceding maximum. The last column gives the distances just referred to. Remarks from observing book are added.

W Sagittarii.

Date. 1895.	Julian 2,410,000 + *d*	Observed brightness.	After maximum. *d*	O−C. *d*
July 13	3388·42	5·6	5·26	−0·3
14	89·44	5·4	6·28	+0·4
15	90·42	4·95	7·26	+0·4
17	92·39	4·9	1·64	+0·9
17	92·44	5·0	1·69	+0·5
18	93·46	5·25	2·71	+0·6
19	94·44	5 5	3·69	+0·9
20	95·45	5·8	4·70	+0·2
21	96·41	5·7	5·66	+0·5
22	97·38	4·7	6·63	−1·0
22	3397·43	5·0	6·68	−0·1
26	3401·39	5·45	3·04	+0·4
27	02·43	5·6	4·08	+0·8
30	05·38	4·8	7·03	−0·5
Aug. 7	3413·35	4·6	7·41	−0·2

Date. 1895.	Julian 2,410,000*d*+ *d*	Observed brightness.	After maximum. *d*	O−C. *d*	
Aug. 11	3417·43	5·6	3·89	+0·7	
12	18·38	5·5	4·84	−0·9	
12	18·40	5·6	4·86	−0·6	
16	22·43	5·3	1·30	−0·9	
17	23·43	5·3	2·30	+0·1	
24	30·42	5·1	1·69	0 0	
Sept. 8	45·33	5·2	1·41	−0·5	
9	46·38	5·6	2·46	−0·8	Clouds about.
29	66·32	4·8	7·21	−0·4	Moon.
Oct. 4	71·30	5·5	4·60	−1·1	Twilight.
7	74·30	5·1	0·01	−1·6	
9	76·30	5·3	2·01	−0·2	
10	77·32	5·4	3·03	+0·5	
11	78·32	5·7	4·03	+0·4	
14	81·31	4·9	7·02	0·0	
16	83·29	5·3	1·40	−0·8	
18	85·32	5·8	3·43	−1·0	
30	3497·27	4·9	0·19	−0·5	Bright moonlight.
Nov. 2	3500·28	5·2	3·20	+1·2	Twilight and Moon.
3	3501·28	5·5	4·20	+1·4	

From the last column we get as the sum of 16 positive residuals 9·9 days, and of 17 negatives 11·4 days. Combining these with the observations of 1893 and 1894, we get the following result :

	No. of Observations with Positive Residuals.	No. of Observations with Negative Residuals.	Sum of Positive Residuals. *d*	Sum of Negative Residuals. *d*
1893	16	22	10·0	14·5
1894	10	14	5·1	12·5
1895	16	17	9·9	11·4
Total	42	53	25·0	38·4

We therefore get 0·60 day as the average value of a positive, and 0·72 day as the average value of a negative residual. On the whole, it seems that the period of 7·59460 days is correct, and the star's variation conforms very regularly to it.

X Sagittarii. Thirty-four observations, treated as in the previous case. Comparison star F 4 *Sagittarii* 5·4 *m.* Chandler's data for this star are—

Elements of maximum 1870 Aug. 16 = 240 4291·78 + 7·01185 E.

Variation 4 to 6. M − *m* = 2·876*d*.

X Sagittarii.

Date. 1895.	Julian 2,410,000*d*+ *d*	Observed brightness.	After maximum. *d*	O−C. *d*	
July 13	3388·42	5·4	2·27	−0·5	
14	89·44	5·7	3·29	0·0	
15	90·42	5·8	4·27	+0·8	
17	92·39	4·5	6·24	−0·7	
17	92·44	4·9	6·29	−0·1	
18	93·46	4·9	0·30	−1·2	
19	94·44	5·1	1·28	−0·8	
20	95·45	5·35	2·29	−0·4	Careful estimate.
21	96·41	5·7	3·25	0·0	
22	97·38	5·6	4·22	+1·2	"Bilious!"
22	3397·43	5·7	4·27	+1·0	
26	3401·39	5·0	1·22	−0·5	Moon.
27	02·43	5·2	2·26	0·0	
30	05·38	5·7	5·21	−0·3	Moon.
Aug. 7	13·35	5·7	6·17	+0·7	
11	17·43	5·1	3·24	+1·2	
12	18·38	5·6	4·19	+1·2	
12	18·40	5·7	4·21	+1·0	
16	22·43	4·7	0·23	−0·4	
17	23·43	5·1	2·23	+0·2	
24	30·42	5·5	2·20	−0·7	
Sept. 8	45·33	5·2	3·09	+0·8	
9	46·38	5·95	4·14	−0·1	Clouds about.
29	66·32	5·6	3·05	0·0	Moon.
Oct. 4	71·30	5·2	1·01	−1·3	
7	74·30	5·4	4·01	+1·3	
9	76·30	5·0	6·01	−0·2	
10	77·32	4·8	0·02	−1·1	
11	78·32	5·0	1·02	−0·7	
14	81·31	5·7	4·01	+0·7	Levanter wind.
16	83·29	5·4	5·99	+0·2	
30	3497·27	5·6	5·94	+0·3	Bright moonlight.
Nov. 2	3500·28	5·4	1·94	−0·8	Observation difficult. Moon and twilight.
3	01·28	5·9	2·94	−1·1	

From the last column we get as the sum of 13 positive residuals 10·6 days, and of 17 negative 10·9 days. Combining

these with the observations of 1893 and 1894, we get the following :

	No. of Observations		Sum of	
	with Positive Residuals.	with Negative Residuals.	Positive Residuals.	Negative Residuals.
1893	25	14	7·2	22·8
1894	5	16	1·8	16·2
1895	13	17	10·6	10·9
Total	43	47	19·6	49·9

Hence for the three years

Average value of a positive residual = 0·46 day

" " negative " = 1·06 day

The observations for 1895 cluster closely round the typical curve, and support it better than those of the two preceding years. In fact, if the most probable curve were drawn among the 1895 observations, independently, I think that such curve would be found to approximate very closely to the pattern light curve. Hence no correction to the period given above seems required.

Y Sagittarii. Compared with 45 (U.A.) of *Sagittarius*, 6·5*m*, 26 observations in 1894, 41 in 1895. Those for 1893 are in vol. xiii. p. 180 of the *Astronomical Journal*. They are treated as before, the data being

1886 Sept. 25 = 241 0175·02 + 5·7732 E.

Variation 5·7 to 7·0. M − *m* = 1·80*d*.

Y Sagittarii.

Date. 1894.	Julian 2 410 000*d* + *d*	Observed brightness.	After maximum. *d*	O−C. *d*	
Aug. 20	3061·41	5·8	5·56	+0·1	
25	66·39	6·6	4·77	+1·0	
26	67·39	6·2	0·00	+0·9	
27	68·33	6·2	0·94	−1·1	Twilight.
27	68·37	6·4	0·98	−1·4	
28	69·38	6·5	1·99	−0·5	
Sept. 4	76·39	6·6	3·22	+0·6	
20	92·38	6·7	1·89	−0·9	Clouds about.
21	93·33	6·8	2·84	−0·3	
22	94·32	6·6	3·83	−0·8	
22	94·38	6·75	3·89	−0·6	
25	97·32	6·55	1·06	−1·4	
25	97·37	6·7	1·11	−1·8	

Date. 1894.	Julian 2,410,000d + d	Observed brightness.	After maximum. d	O−C. d	
Sept. 26	3098·31	6·8	2·05	−1·0	
29	3101·31	6·6	5·05	+0·5	
Oct. 1	03·31	6·7	1·28	−1·6	
2	04·32	6·7	2·29	−0·6	
4	06·31	6·9	4·28	−0·1	
4	06·37	6·8	4·34	−0·1	
21	23·30	7·0	3·95	0·0	
22	24·28	6·4	4·93	+0·2	
24	26·31	6·5	1·18	−1·4	
27	29·30	6·8	4·17	−0·3	
29	31·31	6·3	0·41	−1·6	
31	33·30	6·7	2·40	−0·5	
Nov. 16	3149·27	6·3	1·05	−1·1	Bright twilight.
1895.					
July 13	3388·41	6·15	3·49	−1·5	
14	89·44	6·1	4·52	−0·6	
15	90·43	5·75	5·51	−0·1	
17	92·39	5·9	1·70	+0·7	
17	92·44	6·1	1·75	+0·1	
18	93·47	6·5	2·78	+0·3	
19	94·44	6·7	3·75	−0·8	
20	95·45	6·5	4·76	0·0	
21	96·41	5·7	5·72	0·0	
22	97·38	5·5	0·98	+1·0	
22	97·43	5·9	0·96	−0·1	
26	3401·43	6·2	4·96	0·0	
27	02·43	5·9	0·19	−0·9	
30	05·38	6·4	3·14	+0·9	Moon.
Aug. 7	13·35	5·8	5·34	−0·1	
11	17·43	6·4	3·65	−1·2	
12	18·38	6·6	4·60	−0·1	
12	18·40	6·5	4·62	−0·1	
16	22·43	6·3	2·87	+0·7	
17	23·42	6·45	3·86	−1·0	
24	30·41	6·6	5·08	+0·5	
Sept. 9	46·38	6·6	3·73	+1·0	Clouds about.
29	66·28	6·1	0·54	−1·1	Moon.
Oct. 4	71·30	6·0	5·56	+0·4	

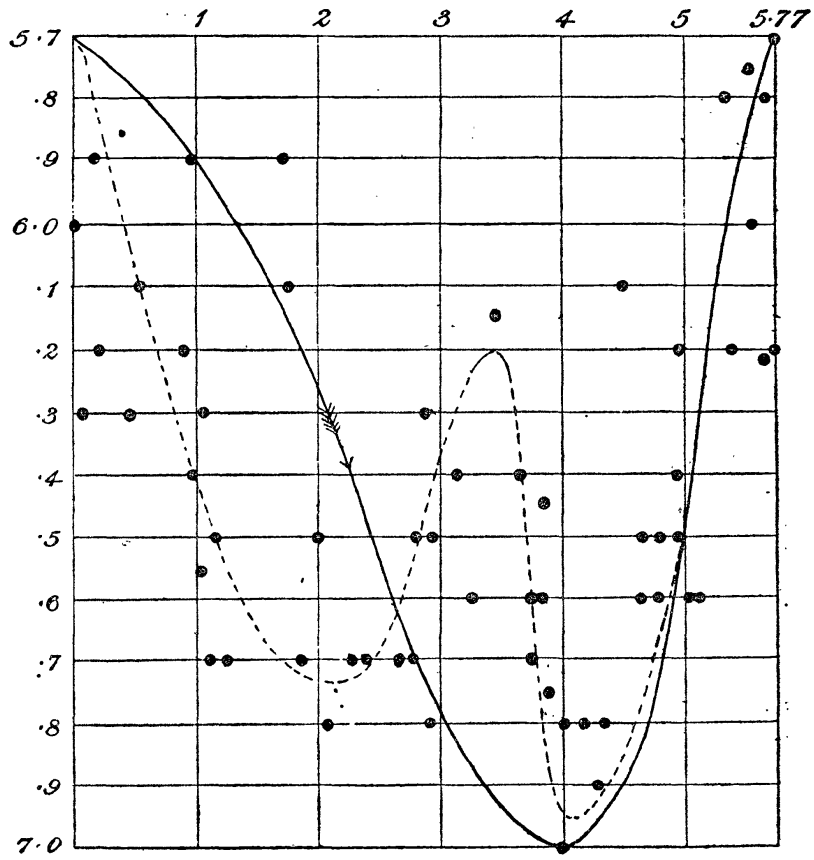
Date. 1894.		Julian 2,410,000d+ d	Observed brightness.	After maximum. d	O−C. d	
Oct.	7	3474·31	6·7	2·80	0·0	
	9	76·30	6·6	4·79	+0·1	
	10	77·31	6·3	0·02	−2·1	
	11	78·32	6·3	1·03	−1·1	
	14	81·31	6·8	4·02	−0·5	
	16	83·29	6·2	0·23	−1·6	
	18	85·32	6·7	2·26	−0·6	
	27	94·31	6·2	5·47	+0·5	Doubtful observation.
	30	3497·27	6·7	2·66	−0·2	
Nov.	2	3500·28	6·22	5·67	+0·7	
	3	01·28	6·2	0·90	−1·1	
	5	03·29	6·5	2·91	+0·4	
	7	05·30	6·5	4·92	+0·2	Clouds about.
	8	06·28	6·0	0·02	−1·3	Clouds about.
	12	10·27	6·8	4·11	−0·3	
	13	11·30	6·6	5·14	+0·4	Getting very low.
	16	3514·28	6·7	2·36	−0·5	

	No. of Observations		Sum of	
	with Positive Residuals.	with Negative Residuals.	Positive Residuals.	Negative Residuals.
1893	22	19	9·7	9·0
1894	19	6	3·3	17·1
1895	22	15	7·9	16·9
Total	63	40	20·9	43·0

Therefore for the three years

Average value of positive residual = 0·33d.
„ „ negative „ = 1·07d.

I attach a drawing of the 1894–95 observations plotted to scale. In several cases the dots fall twice on the same place. An inspection shows that many of the observations cluster very closely round the rising branch, while in the descending branch the dots seem to be more scattered. On the whole, I do not think that for the present any further approach to accuracy could be gained by an alteration of the period. If lengthened or shortened the typical curve would be shifted either to the right or left, and it is plain that either of these movements, although bringing the curve into closer proximity to *some* dots, would yet leave others at a further distance from it. The same argu-



ment applies to a possible systematic error in estimating the star's brightness. In this case the typical curve must go either up or down vertically. Neither of such movements would on the whole, I think, bring it into any better relation to the dots. Neither would a better correspondence be produced by shifting the minimum phase—*i.e.* altering M—*m*. Therefore the adopted period would seem correct.

If, however, in future years the negative residuals go on increasing, it will be necessary to consider a slight diminution of the period.

It is just possible that a secondary maximum is indicated, occurring about 3·3 days after the principal one. I have shown this by a dotted line. Although I am diffident as to the objective reality of the supposed phenomenon, I place it on record here. The observations of future years will settle the question.

The three stars which have been dealt with all appear to belong to the same class, *S* 10 *Sagittæ* being a representative in the northern hemisphere. It is difficult to account for variation of this nature. Whether it be due to eclipses by one or more opaque attendants, to unequal brilliancy of successive portions of the visible disk as presented to the Earth at time of observa-

tion, or to changes in the brilliancy of the star's photosphere—whatever it be due to—the remarkable regularity with which the light waxes and wanes must be always taken into account in the theory, at once differentiating this class from the long-period variables which are subject to great irregularities in their periods.

Gibraltar: 1896 *February* 3.

Melbourne Observatory.

The following letter and report were received by the Secretaries on April 13, too late for inclusion in the Annual Report of the Council :—

"*Observatory, Me'bourne:*
"1896 *March* 10.

"DEAR SIR,—I am sending you herewith a Report of our work in 1895. The very long delay was unavoidably caused by my absence from the Observatory.

"Believe me, very truly yours,
"PIETRO BARACCHI.

The Secretary, Royal Astr. Society, London."

The following is a brief account of the work carried out at the Melbourne Observatory during the year 1895 :—

Meridian Work.—Observations in Right Ascension 2,503, in North Polar distance 1,387, subdivided as follows: viz. 819 observations of standard clock stars, 255 of azimuth stars, 54 special stars observed three times in both coordinates for the Adelaide Observatory, and the remainder, observations of stars for use in connection with our astrophotographic work. With regard to the latter stars it may be stated here that they were taken from a list, which we are gradually completing, consisting of stars selected from the catalogue plates in the zone allotted to this observatory (five stars in each plate suitably distributed for the purpose of facilitating the final reduction of these plates), and intended for observation with the transit circle. 195 of these stars have also been observed at the Adelaide Observatory and Sir Charles Todd has promised further help in this direction. The transit circle was reversed in 1895 March.

Astrophotographic Work.—Number of exposed plates 397, subdivided as follows : viz. catalogue plates 236, chart plates 49, Oxford type charts 26. Plates exposed on the pole for testing the clearness of the night 53, plates for trails 22, for adjustment of the centre 11. Of these 17 were rejected on account of defects in the film, setting, or broken exposure. Each plate was submitted to a preliminary examination in order to ascertain that the general conditions, such as accurate setting, orientation,